Earth Science Enterprise Performance Targets and Indicators

Target 1Y1: Successfully develop, have ready for launch, and operate instruments on at least two spacecraft to enable Earth Science research and applications goals and objectives.

- The Earth Science Enterprise (ESE) will successfully develop, have ready for launch, and operate instruments on at least two spacecraft to enable Science research and applications goals and objectives.
- At least 90% of the total on-orbit instrument complement will be operational.

Target 1Y2: Successfully disseminate Earth Science data to enable our science research and applications goals and objectives.

- Make available data on prediction, land surface, and climate to users within 5 days.
- Increase by 20% the volume of data archived compared to FY00 (target =442 terabytes).
- Increase the number of distinct Earth Observing System Data and Information System (EOSDIS) customers by 20% compared to FY00 (target = 1.5 million).
- Increase products delivered from the Distributed Active Archive Centers (DAACs) by 10% compared to FY00 (Target = 5.4 million).
- User satisfaction: Increase the number of favorable comments from DAAC and Earth Science Information Partner (ESIP) users as recorded in the customer contact logs over FY00. Implement user satisfaction survey.
- Decrease total percentage of order errors by 5% over FY00.

Target 1Y3: Explore the dynamics of the global carbon cycle by developing, analyzing, and documenting multi-year data sets.

- Develop a multiyear global time series of phytoplankton biomass and primary productivity for assessing interannual variability in marine ecosystems on regional scales and daily to interannual time scales. Collect near-daily global measurements of ocean chlorophyll and primary productivity using Moderate Resolution Imaging Spectroradiometer (MODIS) on the EOS Terra and Aqua satellites, merged with SeaWifs data.
- Continue to refresh the global archive of 30 m land imagery seasonally with Landsat-7.
- Use of MODIS on Terra and Aqua to estimate the efficiency of the carbon uptake by phytoplankton (i.e., photosynthesis) for the first time. Also, demonstrate the value of such measurements in assessing carbon and nitrogen cycling in the open ocean by testing their utility in biogeochemical models.
- Estimate global carbon stocks and the role of land ecosystems, and evaluate human impacts on land cover changes. Develop the first global sample of vegetation height and vertical structure by using data from first Earth System Science Pathfinder (ESSP) mission, the Vegetation Canopy Lidar (VCL). Canopy height will be estimated to within 1 meter.

Target 1Y4: Explain the dynamics of global carbon cycle by building improved models and prediction capabilities.

- Through incorporation of data from field experiments and satellite data analysis funded by the Biology and Biogeochemistry of EcoSystems and the Global Carbon Cycle research and analysis programs; improve, by at least 15%, the ecological models

needed to predict ecosystem responses to global environmental changes. This work will be done by NASA-funded investigators at universities and government laboratories.

- Provide information to understand remotely sensed observations of productivity that will be useful for improved prediction and management of food and fiber production. This will be accomplished by extending the long-term 1-4 km satellite record of global terrestrial productivity and its seasonal and interannual dynamics that was begun with the Advanced Very High-Resolution Radiometer (AVHRR). Continued data set with the near-daily global measurements from instruments on the EOS Terra spacecraft, using primarily the MODIS instrument.

Target 1Y5: Explore the dynamics of global water cycle by developing, analyzing, and documenting multi-year data sets.

- Resolve the wide disparity of precipitation estimates that currently exist to within 20 percent, thus improving our understanding of the global water cycle. The Tropical Rainfall Measuring Mission (TRMM) will obtain accurate maps of the diurnal cycle of precipitation and, in conjunction with a 10+ year reanalysis of SSM/I data, set a benchmark allowing us to define the natural variability and climatology for tropical precipitation.
- Decrease the uncertainty in determinations of radiation forcing and feedback, and thereby increase accuracy in our knowledge of heating and cooling of the Earth's surface and its atmosphere. Continue the analysis of global measurements of the radiative properties of clouds and aerosol particles being made by the MODIS, the Multi-Angle Imaging Spectrometer (MISR), and the Clouds and Earth's Radiant Energy System (CERES) instruments on the EOS Terra satellite.

Target 1Y6: Explain the dynamics of global water cycle by building improved models and prediction capabilities.

- Improve current understanding and model the large-scale effects of clouds in climate. Complete collection and processing of satellite data needed for the multi-decadal global cloud climatology being developed under the International Satellite Cloud Climatology Project (ISCCP).
- Validate parameterizations of Earth's radiative processes in models that simulate the cycling of fresh water through Earth's atmosphere. Complete a decadal Surface Radiation Budget (SRB) climatology.
- Demonstrate over a variety of landscapes the capability to measure and diagnose soil moisture from airborne platforms, in preparation for a space-flight trial of soil moisture remote sensing. Soil moisture is an important land surface state variable, currently unmeasured at large spatial scales, that affects weather and climate.

Target 1Y7: Explore the dynamics of long term climate variability by developing, analyzing, and documenting multi-year data sets.

- Complete detailed mapping of thinning/thickening rates for all major ice catchments on the Greenland Ice Sheet. This will serve as a baseline for future satellite-based surveys, to determine the behavior of the ice sheet and its influence on global sea level change. Use airborne laser altimeter data and analysis from the Climate Variability and Prediction Program.
- Use Jason-1 satellite data to continue the measurement of ocean basin-scale sea-level variability and reducing errors to less than 3cm.
- Provide a quantitative understanding of the solar forcing of Earth's climate. Continue acquisition of a total solar irradiance dataset for the complete period of maximum solar activity. Continue the high precision, multi-decadal record of total solar irradiance measurements towards capturing three solar cycles. Enabled by the launch of Active Cavity Radiometer Irradiance Monitor Satellite (ACRIMSAT) in FY00.

Target 1Y8: Explain the dynamics of long term climate variability by building improved models and prediction capabilities.

- Develop and the capability to measure and diagnose open ocean variations in salinity by 0.1 psu in preparation for a space-based system.

- Improve the understanding and modeling of the aerosol radiative forcing of climate and its anthropogenic component. Develop and validate aerosol retrieval and cloud screening algorithms, and processing of satellite data and transport model evaluations for the 20-year climatology of aerosol optical thickness and particle size.

- Demonstrate the experimental seasonal climate predictions based on observations from operating satellites. Use next-generation computing systems and new coupled air-ocean-land-ice models, incorporating all available satellite observations (e.g., TOPEX, Jason, Seawinds, TRMM, SeaWIFS, and MODIS) of key ocean surface parameters such as wind vectors and altimetry.

- Enhance the accuracy of long-term climate variability and change models.

Target 1Y9: Explore the dynamics of atmospheric composition by developing, analyzing, and documenting multi-year data sets.

- Provide continuity of multi-decadal total ozone concentration measurements to aid in characterization of long-term evolution of ozone and enable assessment of ozone recovery processes.
- Continue to monitor atmospheric concentrations of chlorofluorocarbons (CFCs) and new industrial substitutes to understand their impact on ozone concentration.
- Develop a comprehensive climatology of high-resolution ozone vertical distribution in the southern subtropics. This climatology will be used to verify the quality of experimental algorithms used to obtain tropospheric ozone from Total Ozone Mapping Spectrometer (TOMS) data.
- Characterize long-term evolution and interannual variability in high latitude ozone, aerosol, and polar stratospheric cloud profiles.
- Obtain the first measurement of sunrise-to-sunset variations in global ozone aerosol distributions. Also, obtain the first daily diurnally integrated estimates of surface UV radiation using satellite data for the entire sunlit Earth.

Target 1Y10: Explain the dynamics of atmospheric chemistry by building improved models and prediction capabilities.

- Provide increased prognostic ability for Northern Hemisphere high latitude ozone loss in an atmosphere perturbed by an increased abundance of greenhouse gases. This will be accomplished via a comprehensive analysis of data from the SOLVE campaign.
- Provide improved assessment of role of the global budget of carbon monoxide and methane (including its role in the global carbon cycle) through the development of the first global climatology of carbon monoxide and total column methane. This will be accomplished via use of Measurements of Pollution in the Troposphere (MOPITT) instrument aboard the EOS-Terra satellite.
- Characterize atmospheric plume flowing out of East Asia, its evolution as it transits eastward over the Pacific Ocean, and its contribution to global atmospheric chemical composition. Conduct the Transport and Chemical Evolution over the Pacific (TRACE-P) airborne campaign using DC-8 and P3-B together with satellite data and chemistry/transport models.

Target 1Y11: Explore the dynamics of the Earth's interior and crust by developing, analyzing, and documenting multi-year data sets.

- Enable near-real-time assessment of ground deformation for disaster response after earthquakes, continuous monitoring of large structures over time to detect subsidence or landslide vulnerability, and swelling of the ground as a precursor to explosive volcanic eruptions. Provide daily orbit solutions for Global Positioning System (GPS) constellation as a basis for cm-level satellite orbit determinations and mm-level ground based GPS positioning and navigation.
- Conduct global geologic and geomorphic process studies, comparative analysis, improved mapping of terrain features such as floodplains, and input to models for improvement of hazard assessment/mitigation. Conduct analysis of near-global Shuttle Radar Topography Mission (SRTM) 30-meter topographic data.

Target 1Y12: Explain the dynamics of the Earth's interior and crust by building improved models and prediction capabilities.

- Improve understanding of geodynamic processes and allow continuous observations, improved data processing efficiency and reduce operational costs by 20%. Complete the Very Long Baseline Interferometry (VLBI) Mark IV Correlator upgrade.
- Provide a basis for future tectonic modeling and earthquake vulnerability assessment. Complete installation of Southern California Integrated GPS Network (SCIGN) array of 250 precision GPS locators/receivers for monitoring strain accumulation in Southern California.

Target 1Y13: Achieve success with timely development and infusion of technologies. Enable future science missions by increasing technology readiness for mission concepts to reduce their total cost.

- Annually advance at least 25% of funded instrument technology developments one TRL.
- Develop advanced information systems technologies and concepts for processing, archival, access, and visualization of ESE data.
- Develop at least 3 technologies to demonstrate in space with the third Earth Observer New Millennium satellite.
- Transfer at least one technology development to a commercial entity for operational use.

Target 1Y14: Provide regional decision-makers with scientific and applications products/tools.

- Establish at least a second of seven Regional Earth Science Application Center (RESAC) as a self-sustaining entity.
- Improve availability of Landsat data to State and local governments by producing a digital image database of all 50 states once every two years (first of two-year cycle).
- Develop capability to assess the vulnerability of fishing grounds due to water quality issues using remote sensing and ground based information.
- Develop experimental models to demonstrate an ability to improve forecast skill levels for projecting the paths of severe storms using satellite derived sea surface winds, precipitation & surface temperature from QuikScat, TRMM, Seawinds 1A, Terra, Ocean Topography Experiment (TOPEX) and Jason-1.
- Develop a prototype capability to monitor and predict the track of at least one key atmospheric pollutant.
- Develop a predictive capability for outbreaks of malaria in Central Africa.
- Initiate two Applications Research projects with the public and private sector to develop and assess techniques to monitor and verify carbon storage in vegetation and soils.

- Develop at least two new data products for routine decision-making by user organizations involved in ESIP Cooperative Agreements and the Agriculture, Forestry and Rangeland Cooperative Agreements and Grants.

Target 1Y15: Improve access to and understanding of remotely sensed data and processing technology.

- Foster applications of remote sensing data and processing technology by involving at least 20 states in using Earth Science observations, information through informational workshops.
- Increase the operational application of remote sensing technology by initiating at least ten joint Application Research pilot projects (5-yr projects) with State and local governments addressing their specific needs as identified at planning workshops.
- Develop workforce skills needed in remote sensing, Geographic Information System (GIS), and other attending technologies by implementing at least ten active student internships at the State and local level.

Target 1Y16: Stimulate the development of a robust commercial remote sensing industry.

- Develop ten new market commercial products (e.g., oil spill containment software by EarthSat and map sheet products by Earth Resources Data Analysis System (ERDAS), Inc.), in joint commercial applications research projects.
- Identify at least one new commercial source of science data as a result of the Scientific Data Purchase activities for Earth Science research and applications.
- Develop four new validated commercial information products as a result of verification and validation partnerships with the private sector and other users through the Mississippi State Commerce Initiative and the Space Act Agreement.
- Conduct Earth Observation Commercial Applications Program (EOCAP) Technology projects that result in ten prototype products that quantify the utility of Hyperspectral and Synthetic Aperture Radar (SAR) technologies and define future market requirements.
- Increase the cost share leveraging with companies, academia and other government agencies within the EOCAP and Affiliated Research Centers (ARC) programs by 10%.

Target 1Y17: Increase efficiencies in food and fiber production with the aid of remote sensing.

- Conduct at least 30 joint applications research endeavors in conjunction with the U.S. Dept of Agriculture.

Target 1Y18: Increase public understanding of Earth system science through formal and informal education.

- Continue 90 existing grants and award 50 new graduate student research and education grants.
- Continue 17 early career grants in research/education and initiate at least two new collaborative projects in the Earth Science international young investigator program.
- Conduct at least 400 workshops training K-12 teachers of OES education products; a 13% increase over FY2000.
- Increase participating teachers in Global Learning and Observation to Benefit the Environment (GLOBE) to 13,800, and increase participating countries to 87.